23/11/2015 الاثنين م.غريب المحاضرة 7

Properties of DFT

① Periodic Property

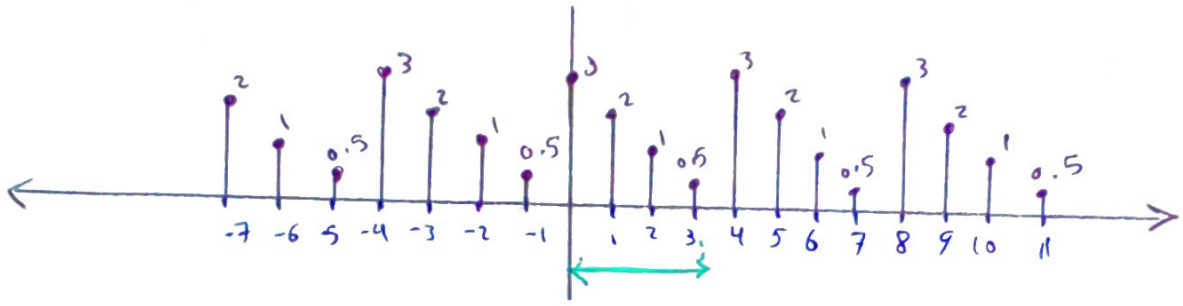
$$X(K) = X(K+N)$$

② Linearity

$$X_1(n) + X_2(n) \Rightarrow X_1(K) + X_2(K)$$

③ Circular Shift

$$x(n) = \{3, 2, 1, 0.5\}$$



$$x((n-1))_4 = \{0.5, 3, 2, 1\} \quad ; \quad x((n+1))_4 \{2, 1, 0.5, 3\}$$

$$x((-n))_4 = \{3, 0.5, 1, 2\}$$

Example:- $x(n) = \{1, 2, -1, 3, \frac{1}{2}\}$

Find:

$x((-n))_5 \Rightarrow \{1, \frac{1}{2}, 3, -1, 2\}$

$x((2-n))_5 \Rightarrow \{-1, 2, 1, \frac{1}{2}, 3\}$

$x((-2-n))_5 \Rightarrow \{3, -1, 2, 1, \frac{1}{2}\}$

$x((n-2))_5 \Rightarrow \{3, \frac{1}{2}, 1, 2, -1\}$

$x((n+2))_5 \Rightarrow \{-1, 3, \frac{1}{2}, 1, 2\}$

Circular Convolution:-

$$y(n) = x_1(n) \textcircled{N} x_2(n) = \sum_{m=0}^{N-1} x_1(m)\, x_2((n-m))_N$$

$x_1(n) = \{1, 2, 0, 1\}$

$x_2(n) = \{2, 2, 1, 1\}$

$$y(n) = \begin{pmatrix} 2 & 1 & 1 & 2 \\ 2 & 2 & 1 & 1 \\ 1 & 2 & 2 & 1 \\ 1 & 1 & 2 & 2 \end{pmatrix} \begin{pmatrix} 1 \\ 2 \\ 0 \\ 1 \end{pmatrix} = \begin{pmatrix} 6 \\ 7 \\ 6 \\ 5 \end{pmatrix}$$

Another method

: 1 0 2 1

1 1 2 2

2 0 4 2

0 4 2 2

2 1 1 0

1 1 0 2

5 6 7 6

Microcontroller VS. DSP

$$X(K) = \sum_{n=0}^{N-1} x(n)\, W_N^{Kn}$$

$$W_N^{K+N} = W_N^K$$

$$W_N^{K+N/2} = -W_N^K$$

$$W_N^2 = W_{N/2}$$

$$\sum_{n=\text{even}} x(n) W_N^K + \sum_{n=\text{odd}} x(n)\, W_N^K$$

$$\sum_{n=0}^{N/2-1} x(2n)\, W_N^{2Kn} + \sum_{n=0}^{N/2-1} x(2n+1)\, W_N^{2Kn}$$

W_N^K → constant